

FIG. 1

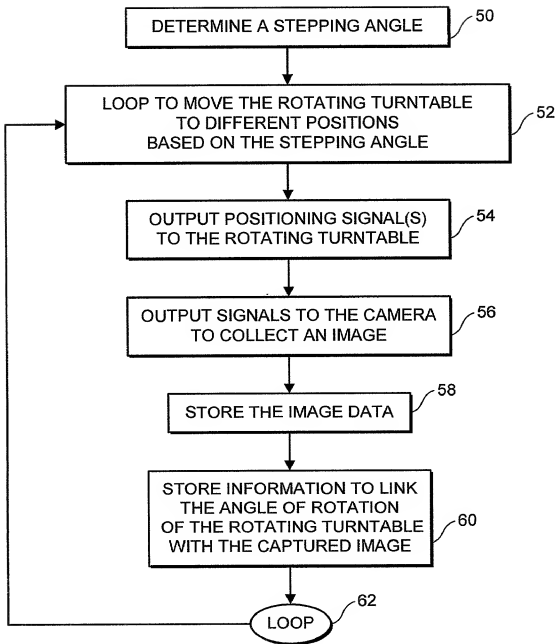


FIG. 2

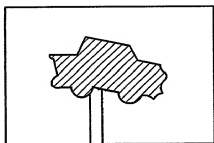


FIG. 3A

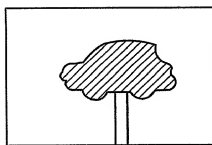


FIG. 3E

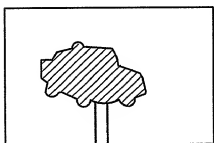


FIG. 3B

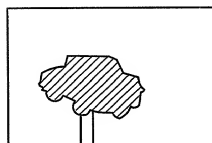


FIG. 3F

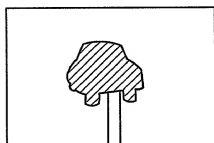


FIG. 3C

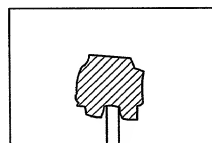


FIG. 3G

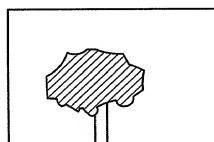


FIG. 3D

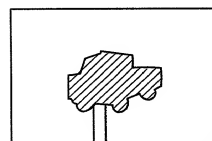


FIG. 3H

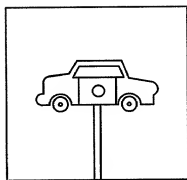


FIG. 5a

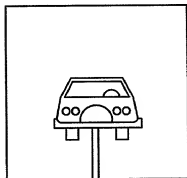


FIG. 5b

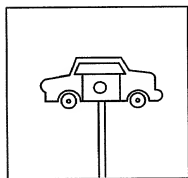


FIG. 5c

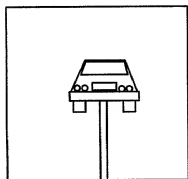


FIG. 5d

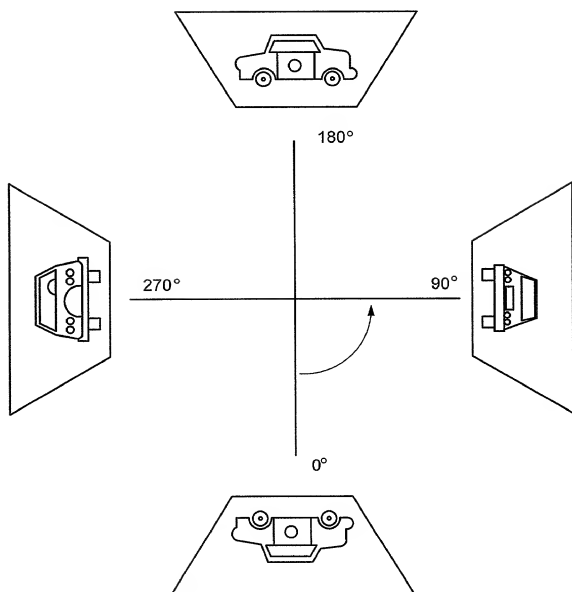


FIG. 6

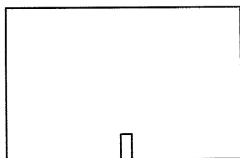


FIG. 7

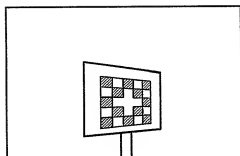


FIG. 8A

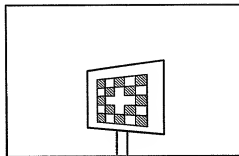


FIG. 8B

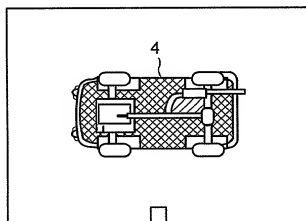
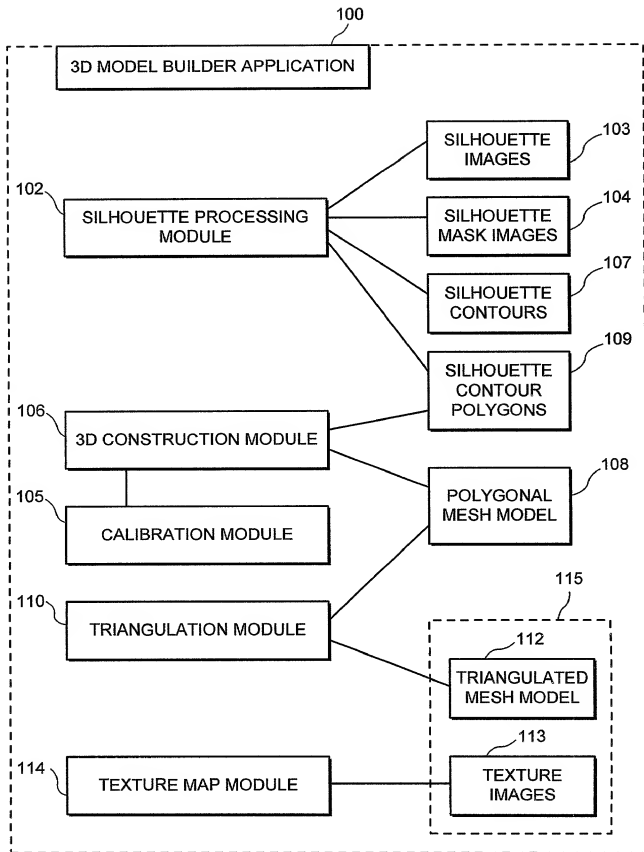


FIG. 9



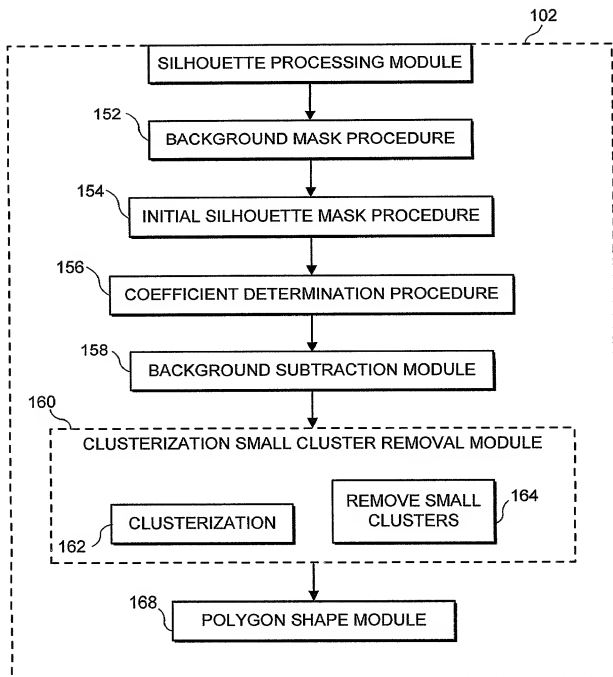


FIG. 11

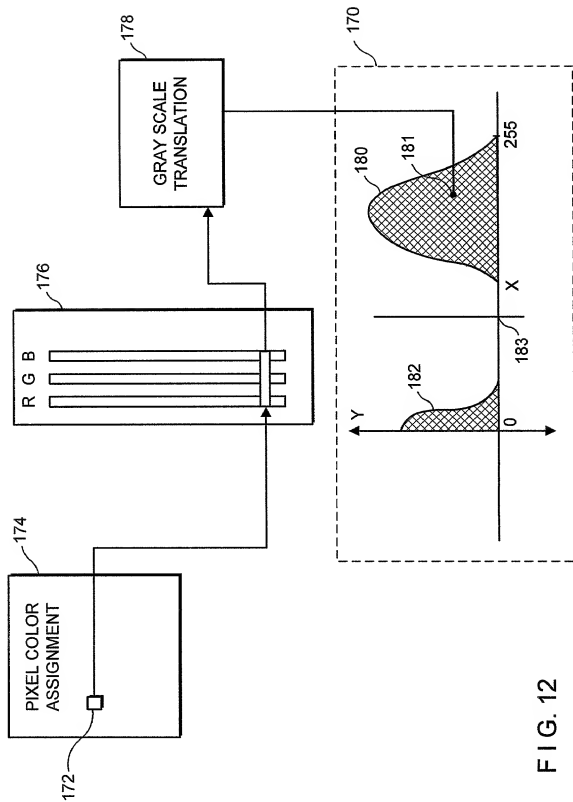


FIG. 12

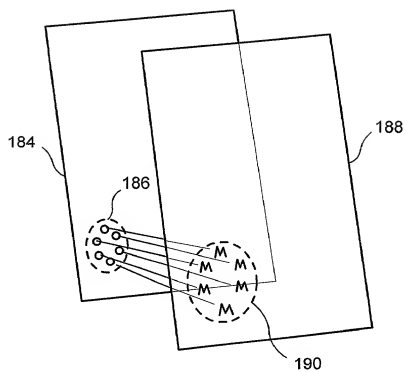


FIG. 13

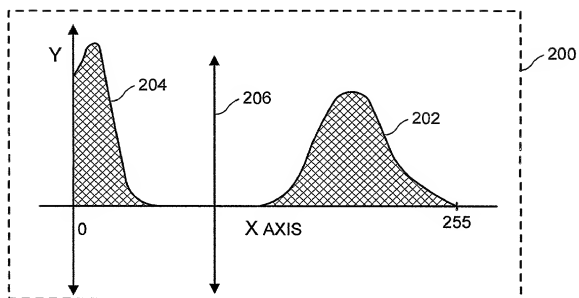


FIG. 14

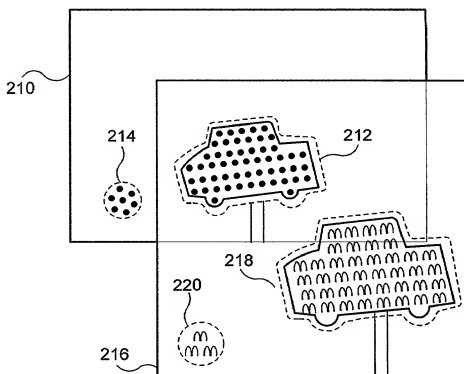


FIG. 15

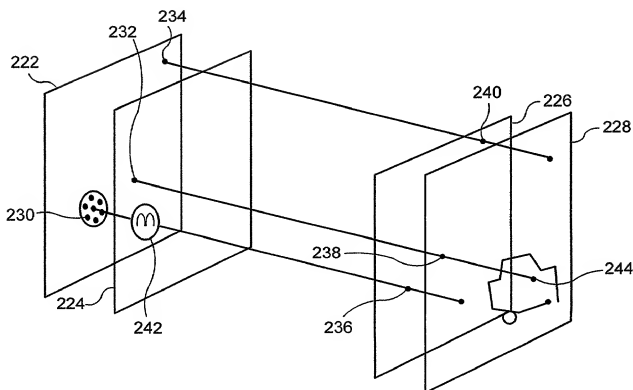


FIG. 16

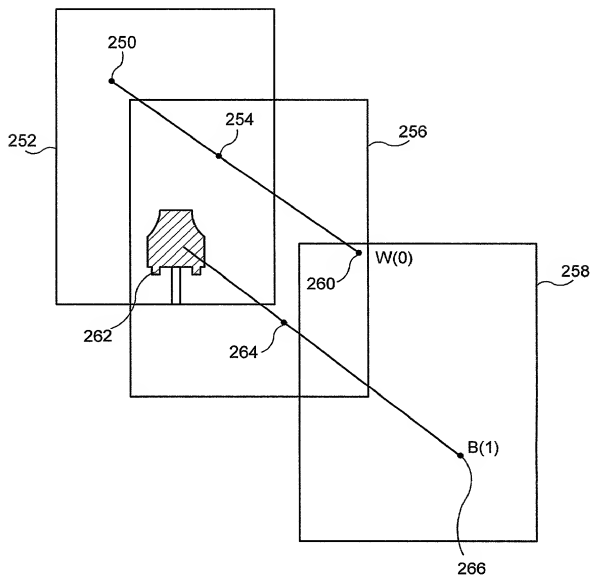


FIG. 17

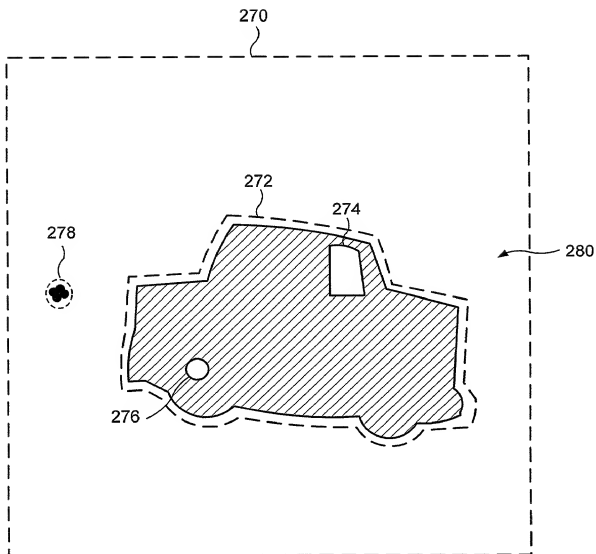


FIG. 18

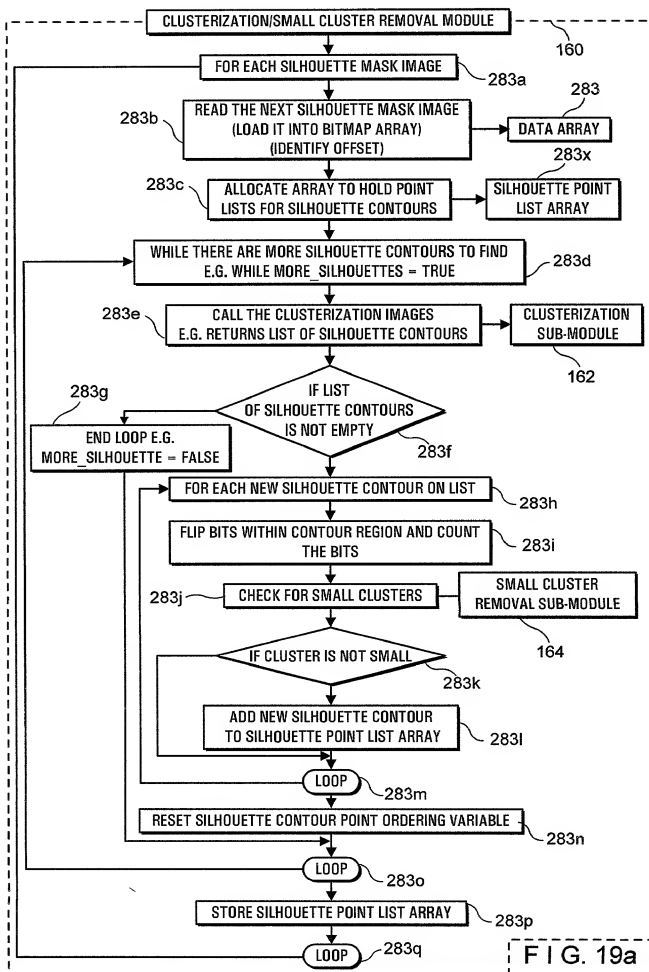


FIG. 19a

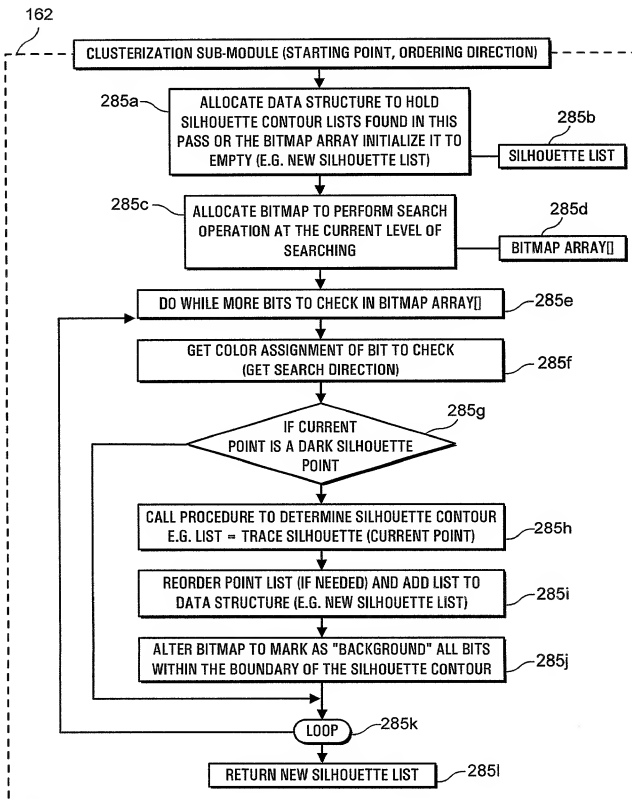


FIG. 19b

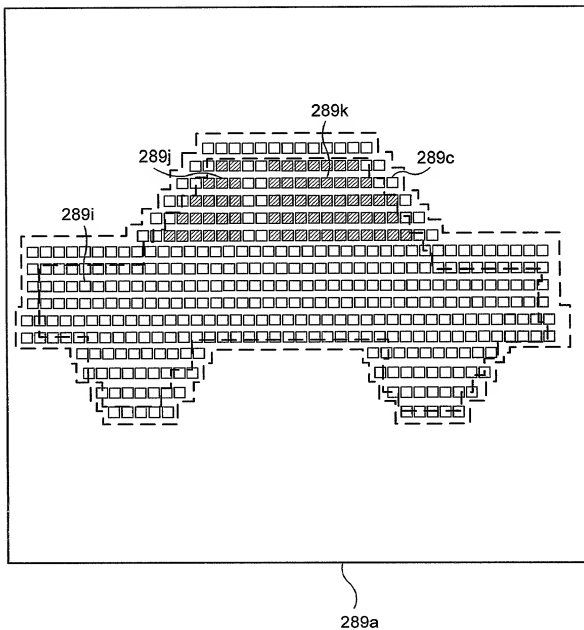


FIG. 19d

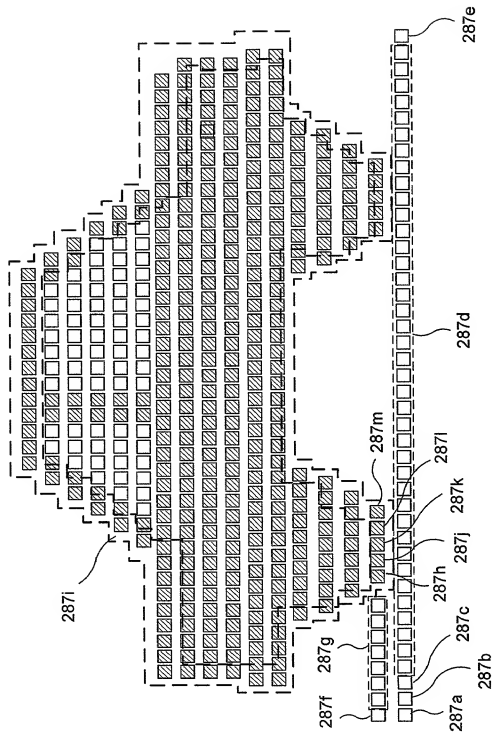


FIG. 19e

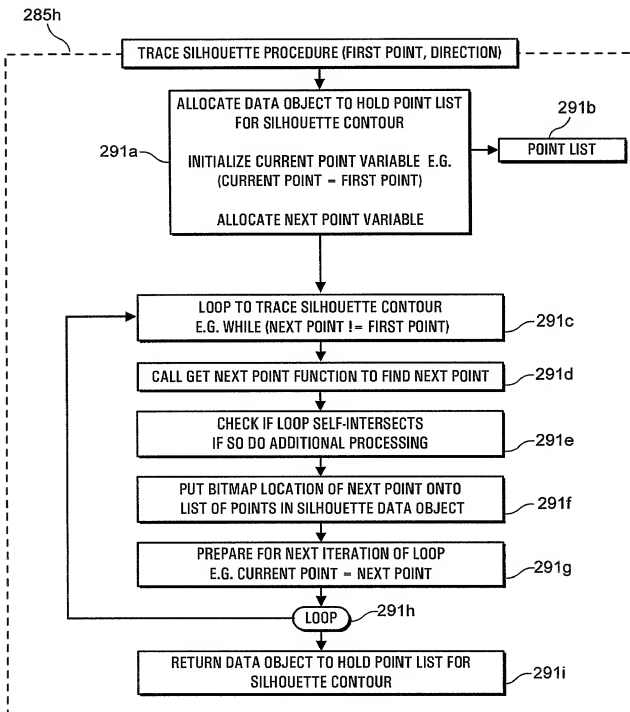


FIG. 20a

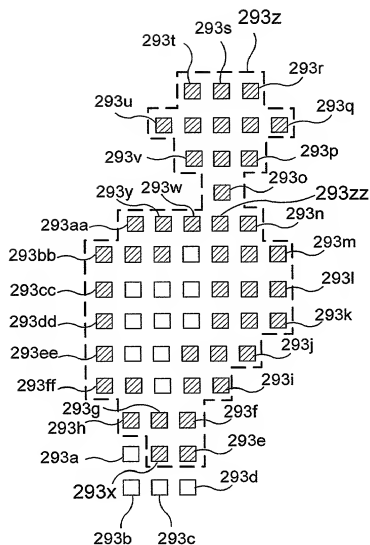


FIG. 20b

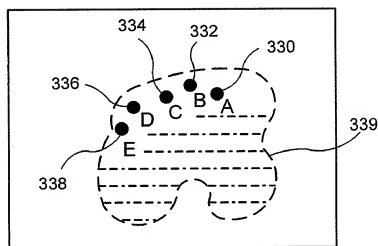


FIG. 21a

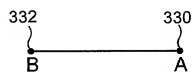


FIG. 21b

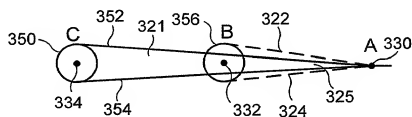


FIG. 21c

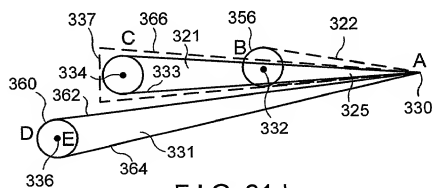


FIG. 21d

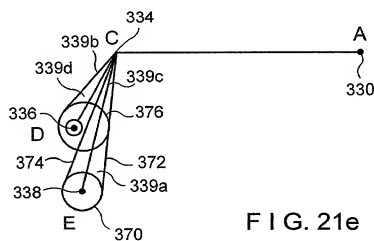


FIG. 21e

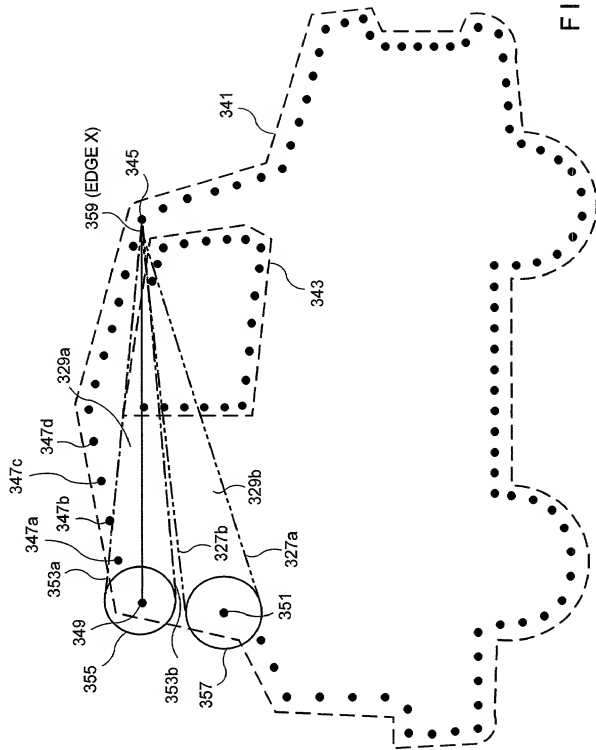


FIG. 22a

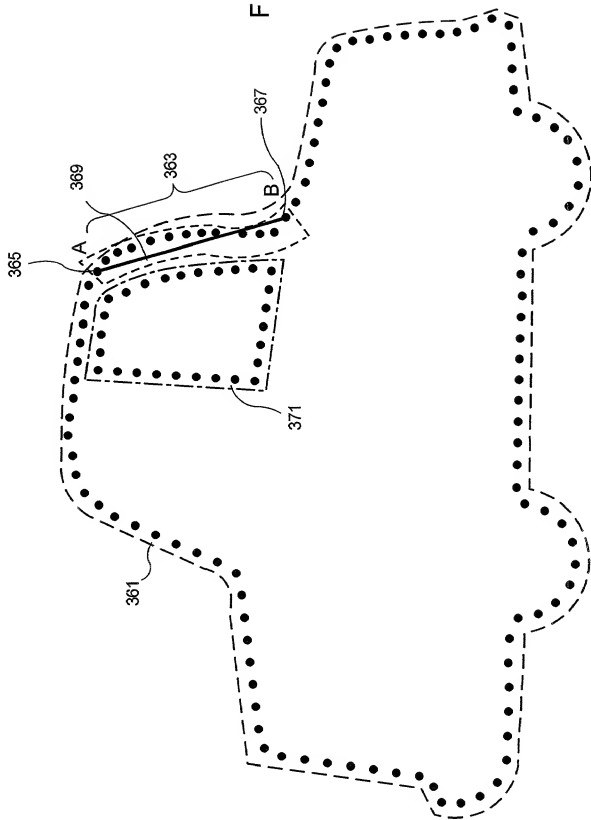


FIG. 22b

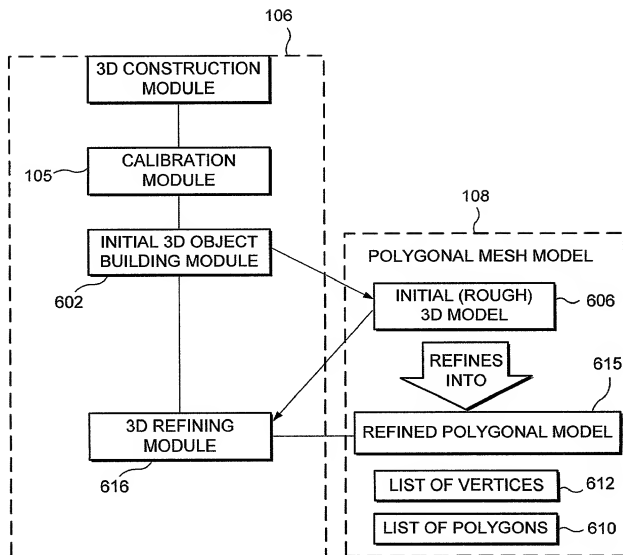


FIG. 23

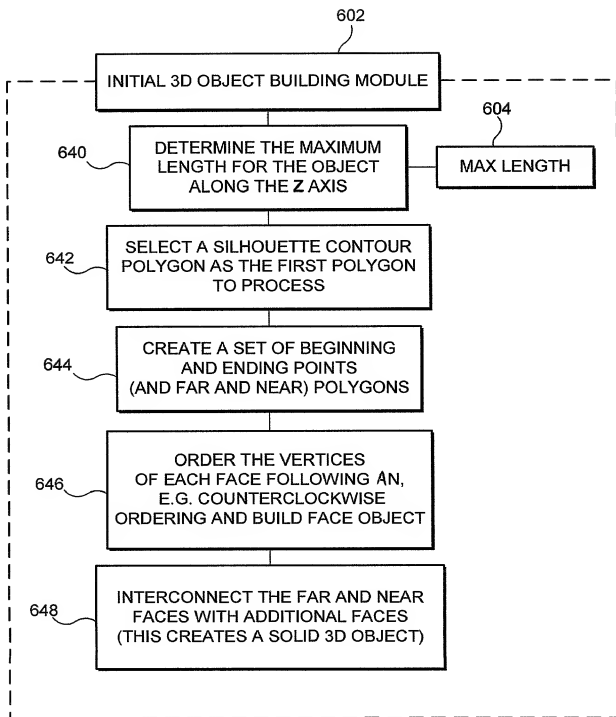


FIG. 24

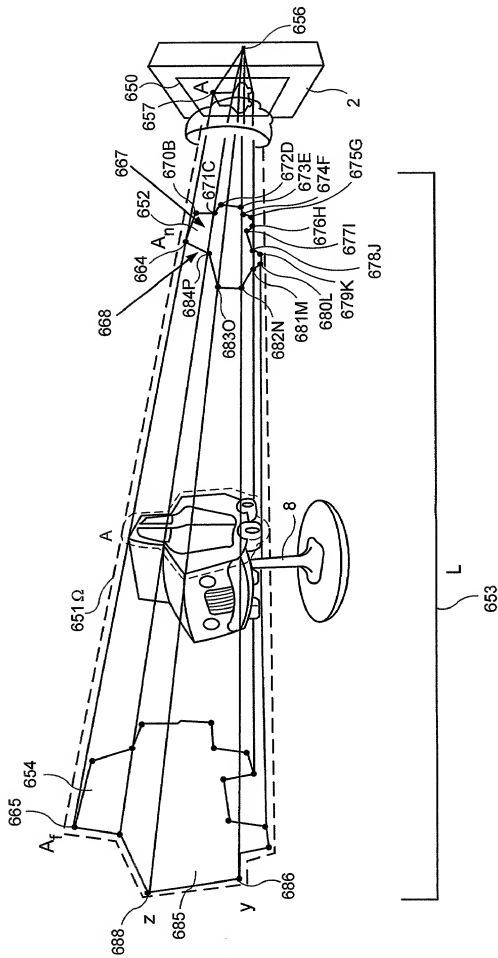


FIG. 25

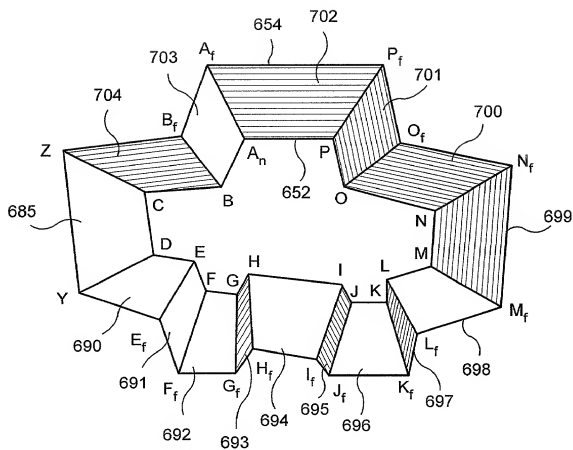
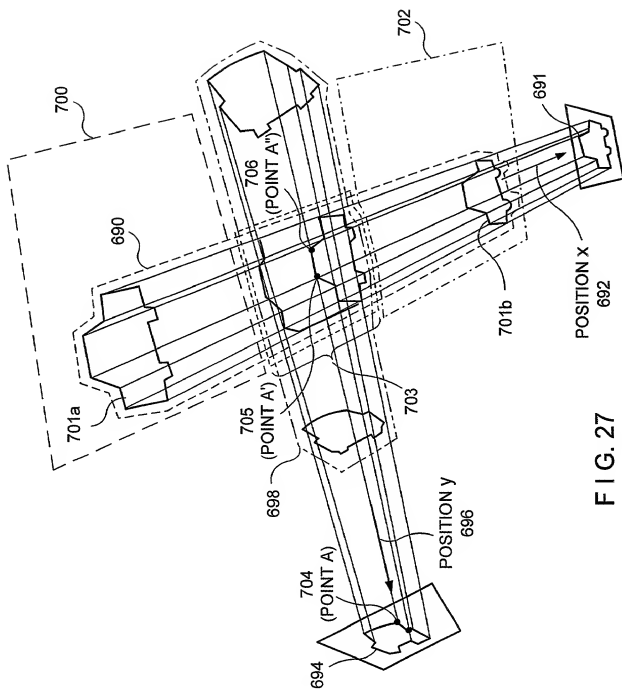


FIG. 26



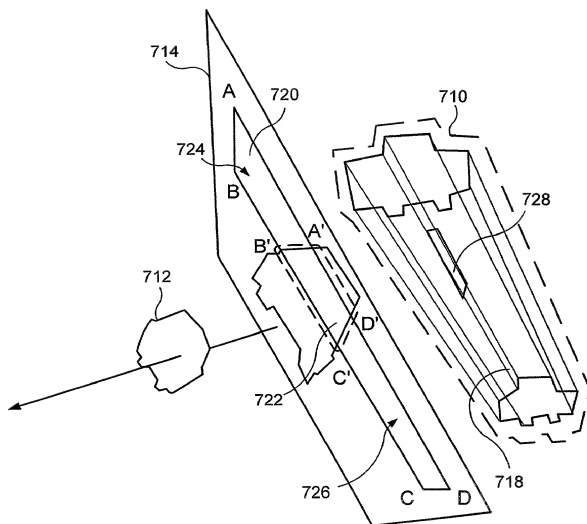


FIG. 28

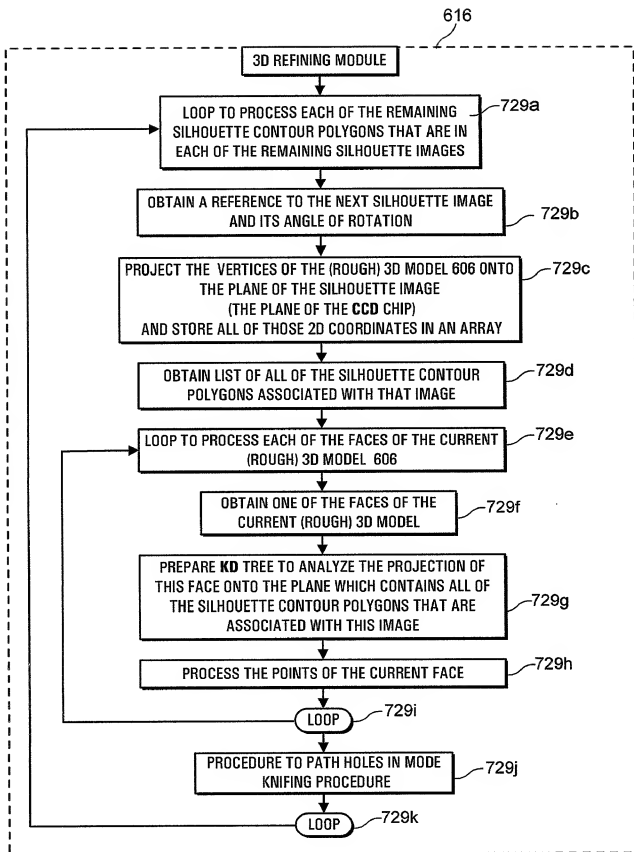


FIG. 29a

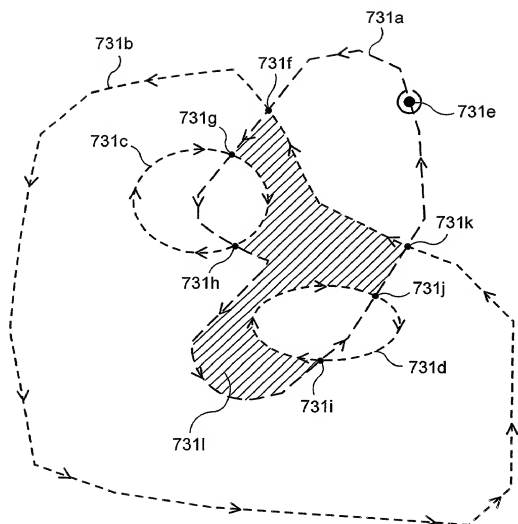


FIG. 29b

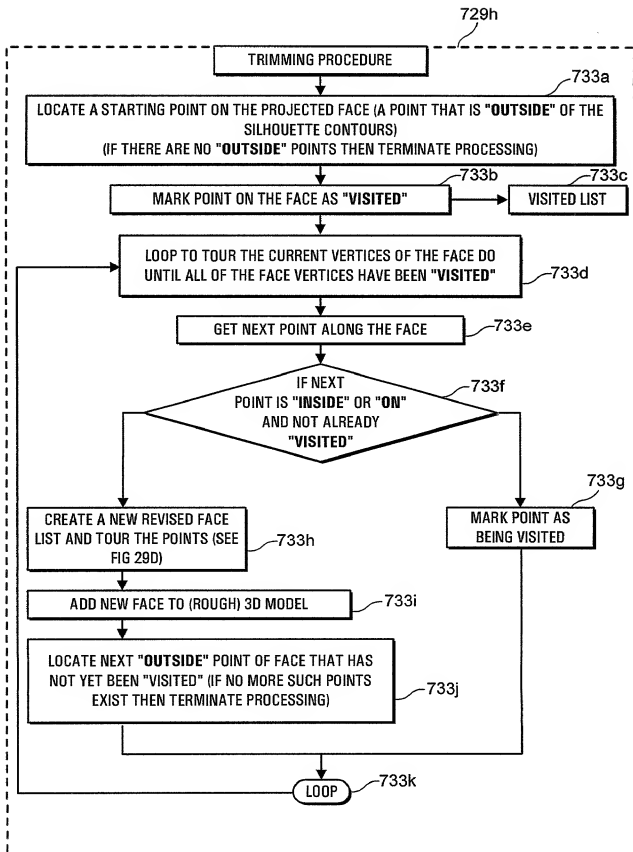


FIG. 29c

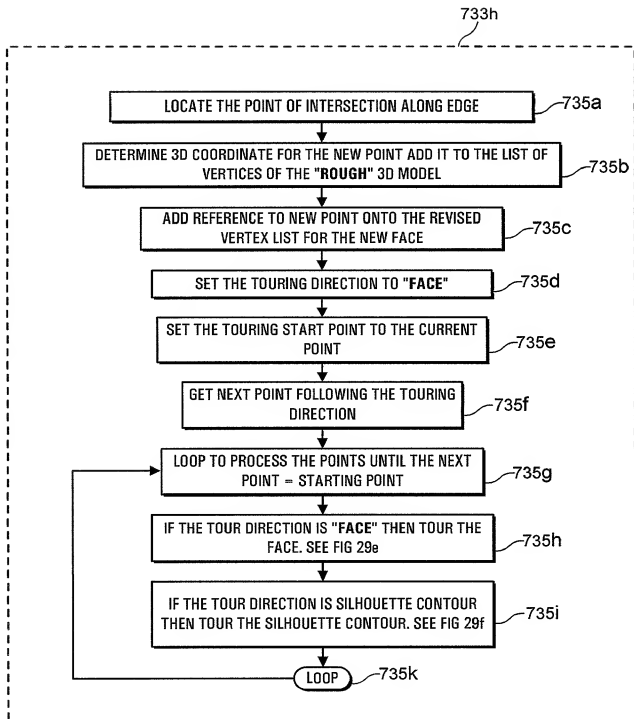
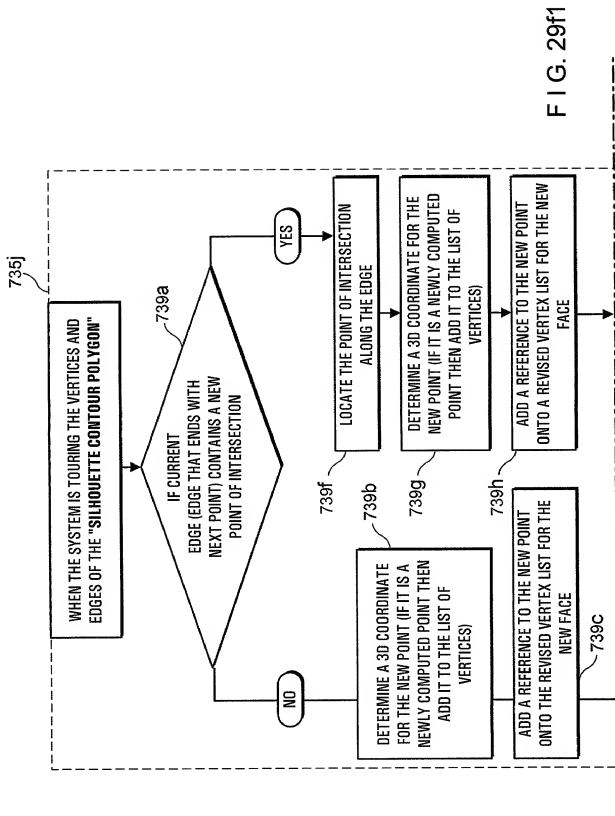


FIG. 29d

```

graph TD
    Start([735i: WHEN THE SYSTEM IS TOURING THE VERTICES AND EDGES OF THE "FACE"]) --> Decision{737a: IF CURRENT EDGE (EDGE THAT ENDS WITH NEXT POINT) CONTAINS A NEW POINT OF INTERSECTION}
    Decision -- NO --> Step737b[737b: ADD A REFERENCE TO THE NEW POINT ONTO THE REVISED VERTEX LIST FOR THE NEW FACE]
    Decision -- YES --> Step737d[737d: LOCATE THE POINT OF INTERSECTION ALONG THE EDGE]
    Step737d --> Step737e[737e: DETERMINE A 3D COORDINATE FOR THE NEW POINT (IF IT IS A NEWLY COMPUTED POINT THEN ADD IT TO THE LIST OF VERTICES)]
    Step737e --> Step737f[737f: ADD A REFERENCE TO THE NEW POINT ONTO A REVISED VERTEX LIST FOR THE NEW FACE]
    Step737f --> Step737g[737g: ADD A REFERENCE TO THE NEW POINT ONTO A KNIFING LIST ASSOCIATED WITH THE CURRENT EDGE OF THE SILHOUETTE CONTOUR POLYGON BEING INTERSECTED]
    Step737g --> Step737h[737h: SET THE TOURING DIRECTION TO BE THE SILHOUETTE CONTOUR THAT WAS JUST INTERSECTED]
    Step737h --> Step737i[737i: GET NEXT POINT BY SILHOUETTE CONTOUR (FOLLOWING VERTEX LIST OF SILHOUETTE CONTOUR)]
    Step737b --> Step737c[737c: GET NEXT POINT BY FACE (FOLLOWING FACE VERTEX LIST)]
    Step737c --> End([735h: RETURN TO LOOP IN STEP 735h])
    Step737i --> End
    
```

F I G. 29e



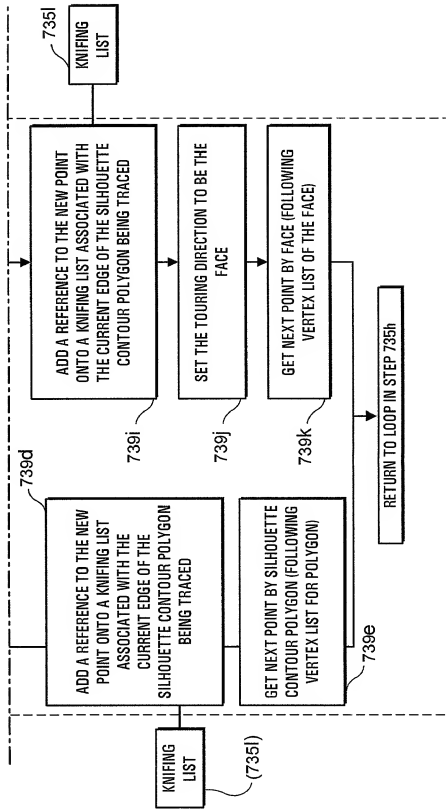


FIG. 29f2

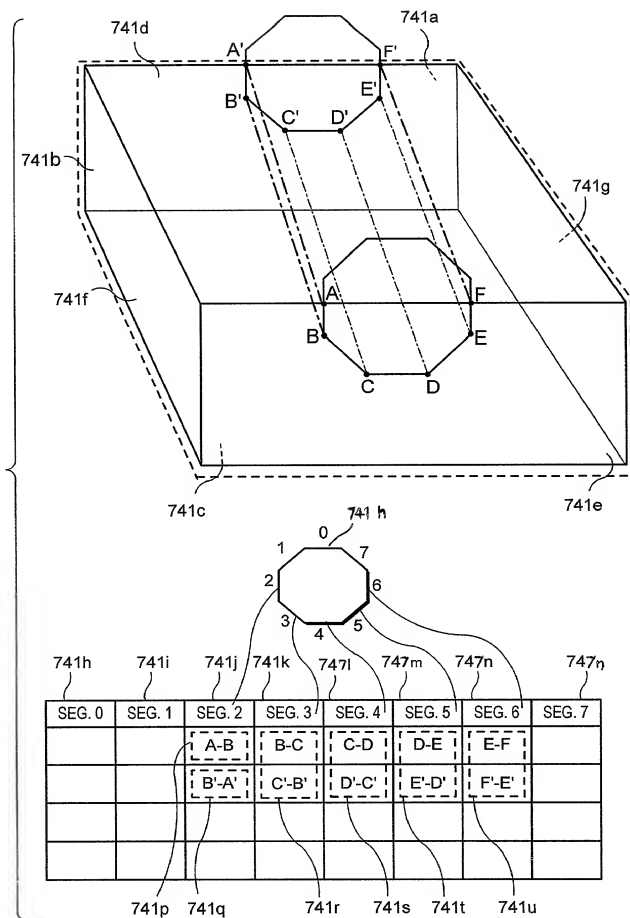


FIG. 30A

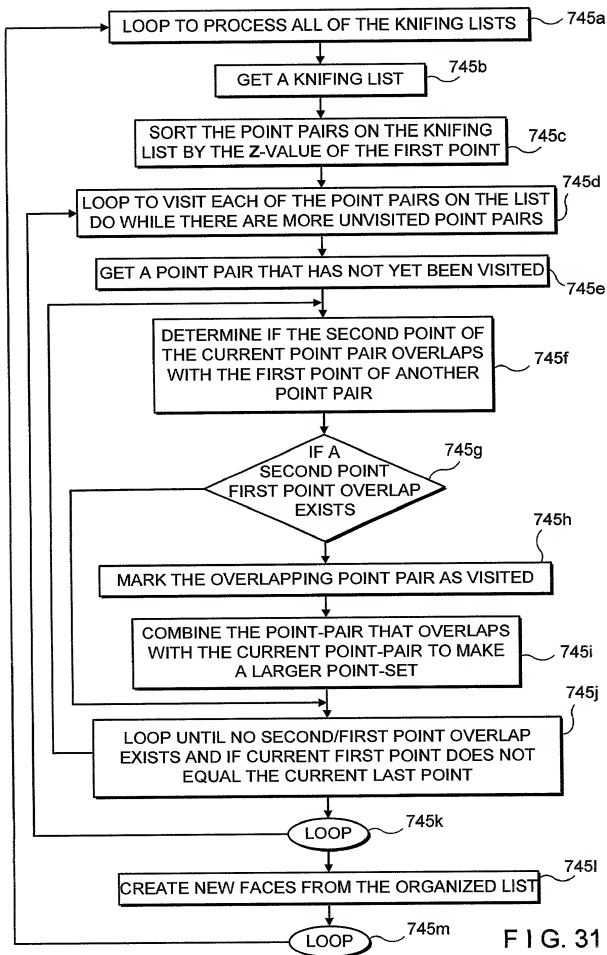


FIG. 31

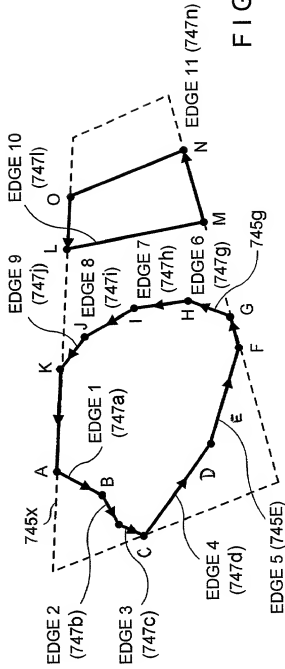


FIG. 32a

EDGE 1	EDGE 5	EDGE 8	EDGE 2	EDGE 6	EDGE 4	EDGE 7	EDGE 3	EDGE 9	EDGE 10	EDGE 11
A: 30, 80, 50 E: 20, 20, 43 I: 70, 60, 90 B: 20, 65, 40 F: 25, 10, 50 J: 60, 80, 75 C: 10, 50, 30 H: 70, 30, 92 D: 15, 42, 32 G: 60, 15, 80 O: 90, 26, 115 N: 80, 55, 100 M: 82, 25, 110 Q: 95, 40, 120										

FIG. 32b

EDGE 3	EDGE 4	EDGE 2	EDGE 5	EDGE 1	EDGE 6	EDGE 9	EDGE 7	EDGE 8	EDGE 10	EDGE 11
C: 10, 50, 30 D: 15, 42, 32 B: 20, 65, 40 E: 20, 20, 43 A: 30, 80, 50 J: 60, 80, 75 G: 60, 15, 80 H: 70, 30, 92 I: 70, 60, 90 F: 25, 10, 50 K: 50, 85, 70 M: 82, 25, 110 O: 95, 40, 120										

FIG. 33

	747c	747d	747b	747e	747a	747j	747g	747i	747h	747l	747n
	Edge 3	Edge 4	Edge 2	Edge 5	Edge 1	Edge 9	Edge 6	Edge 8	Edge 7	Edge 10	Edge 11
e4	C:10,50,30 D:15,42,32 E:20,20,43 F:25,10,50	D:15,42,32 E:20,20,43 F:25,10,50	B:20,65,40 C:10,50,30	E:20,20,43 F:25,10,50	A:30,80,75 B:20,65,40	J:60,80,75 K:50,85,70	G:60,15,80 H:70,30,92	I:70,60,90 J:60,80,75	H:70,30,92 I:70,60,90	L:80,55,100 M:82,25,110	N:90,26,115 O:95,40,120
e5											

747o

747p

Fig. 34

	747b	747a	747j	747g	747i	747h	747l	747n
	Edge 2	Edge 1	Edge 9	Edge 6	Edge 8	Edge 7	Edge 10	Edge 11
e3	B:20,65,40 C:10,50,30	A:30,80,75 B:20,65,40	J:60,80,75 K:50,85,70	G:60,15,80 H:70,30,92	I:70,60,90 J:60,80,75	H:70,30,92 I:70,60,90	L:80,55,100 M:82,25,110	N:90,26,115 O:95,40,120
e4	D:15,42,32							
e5	E:20,20,43 F:25,10,50							

747q

Fig. 35

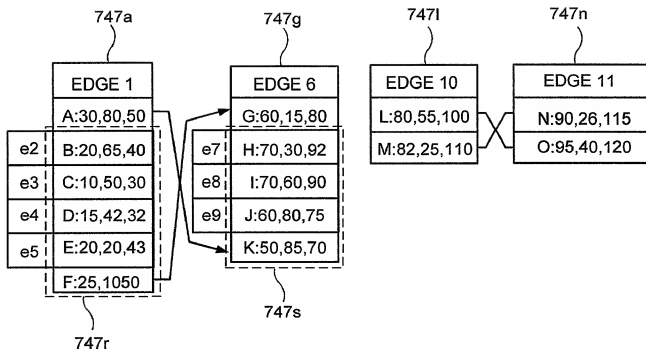


FIG. 36

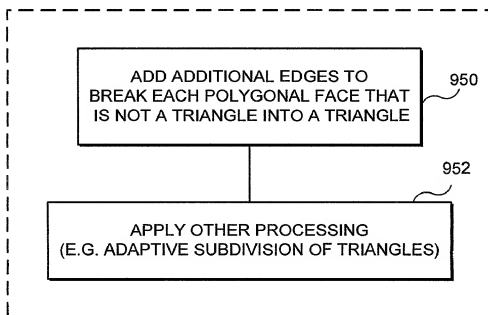
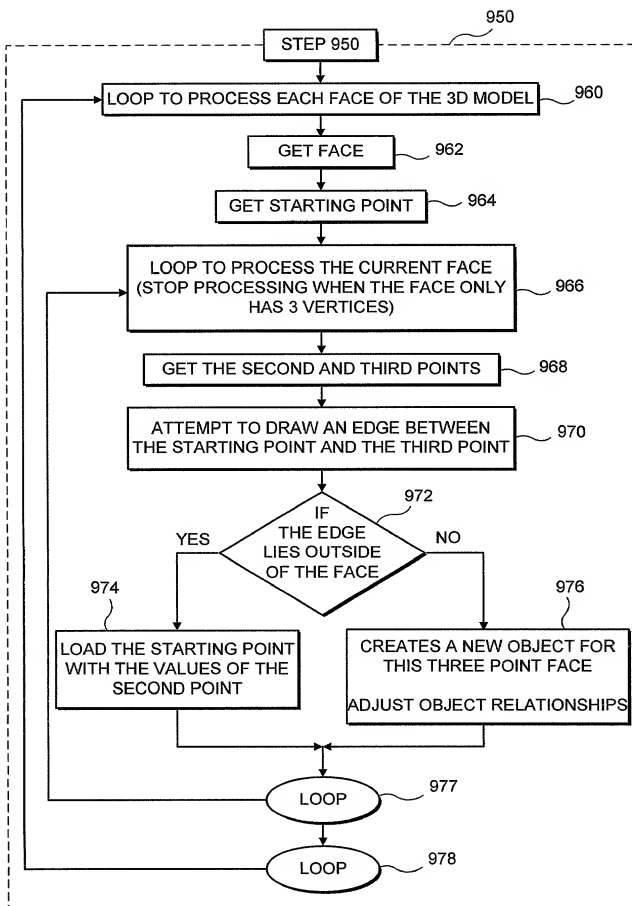


FIG. 37



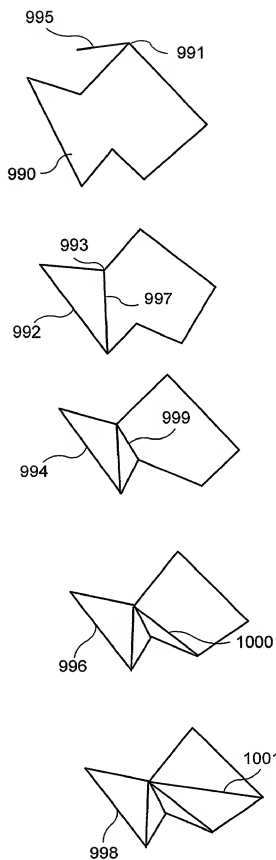
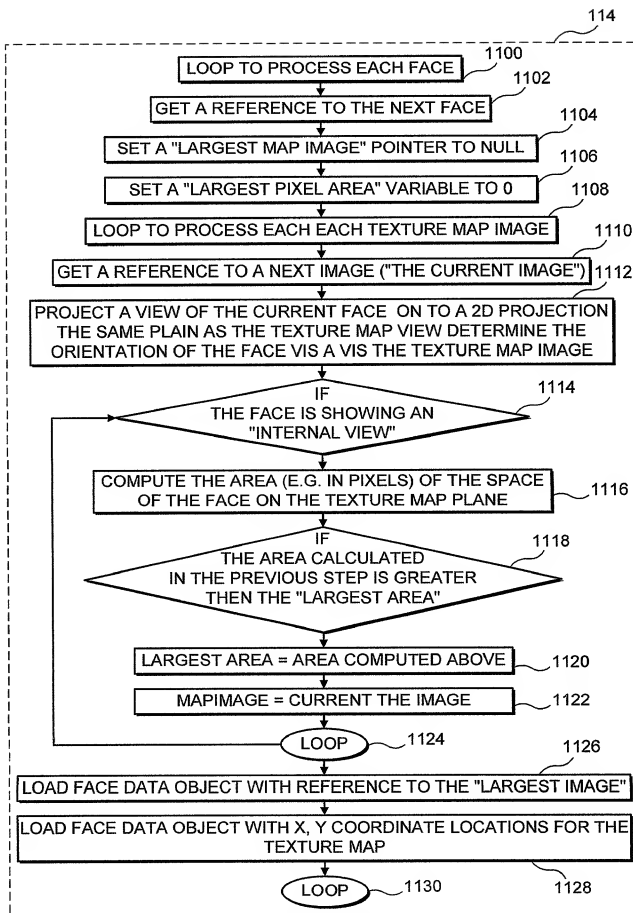


FIG. 39



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99

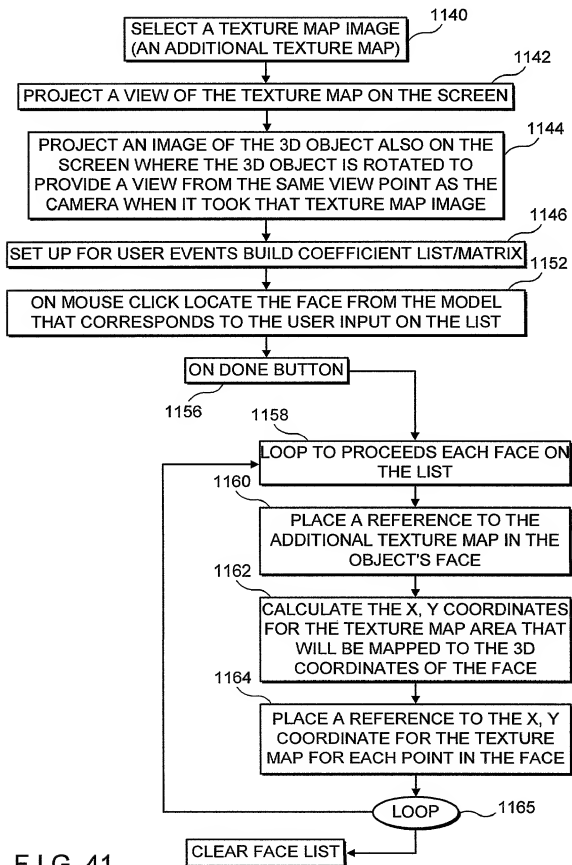


FIG. 41

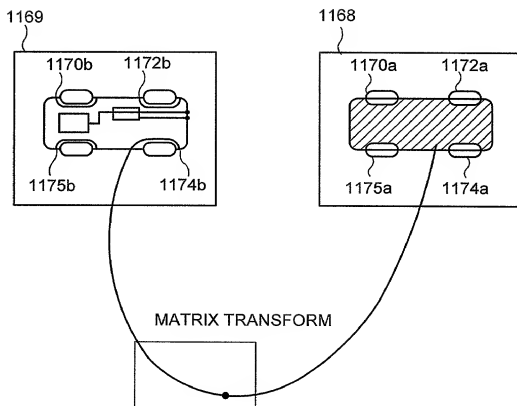


FIG. 42

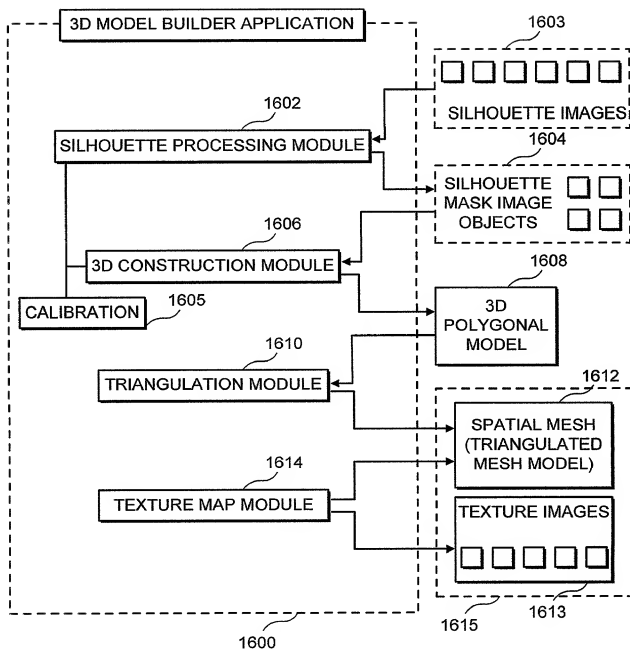


FIG. 43

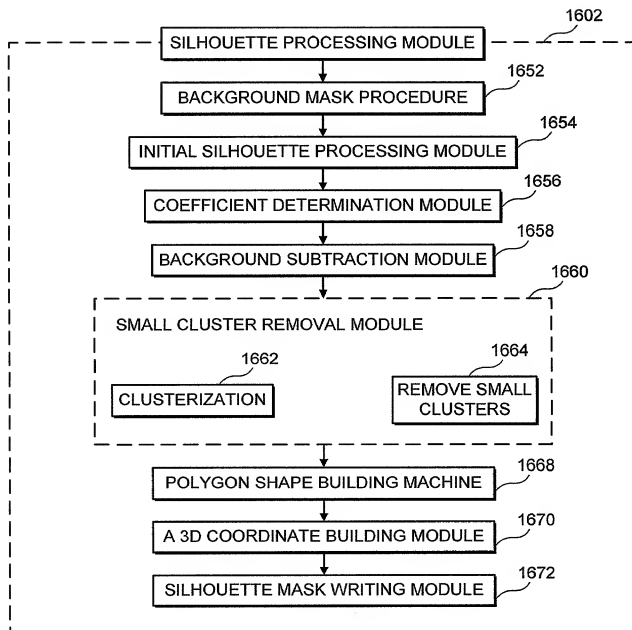


FIG. 44

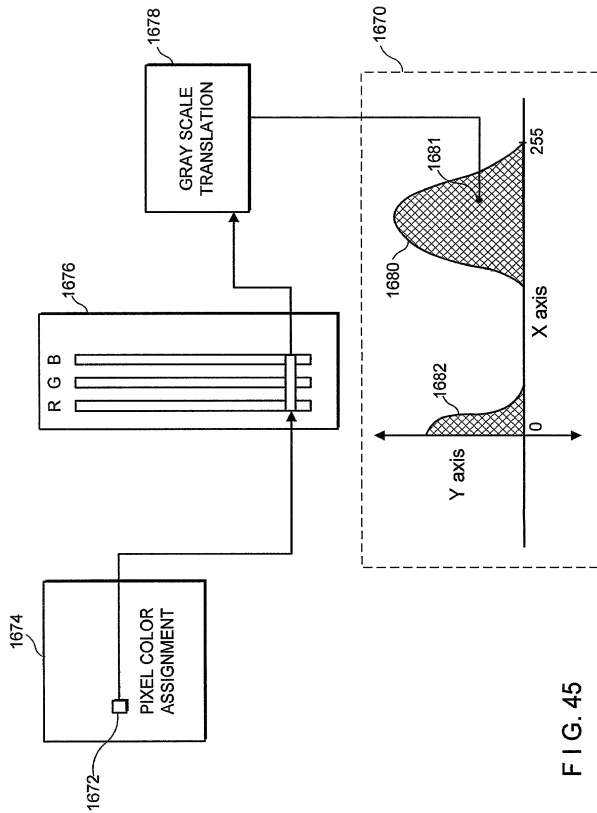


FIG. 45

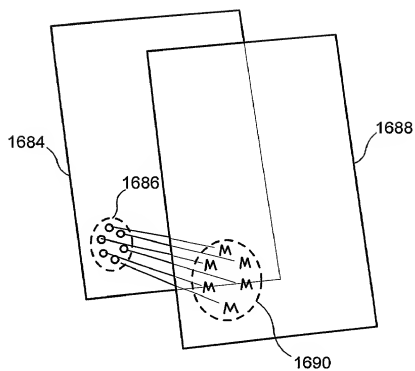


FIG. 46

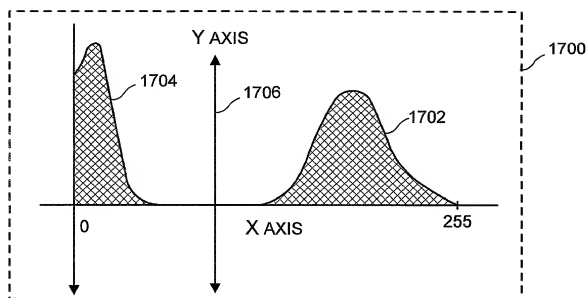


FIG. 47

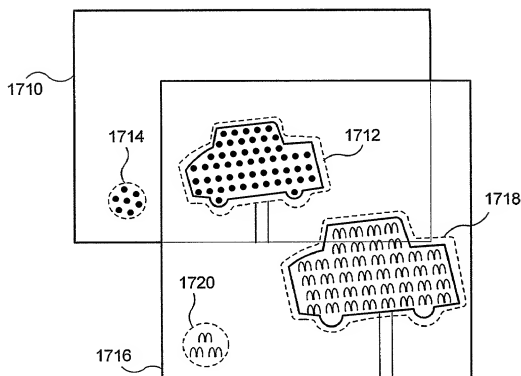


FIG. 48

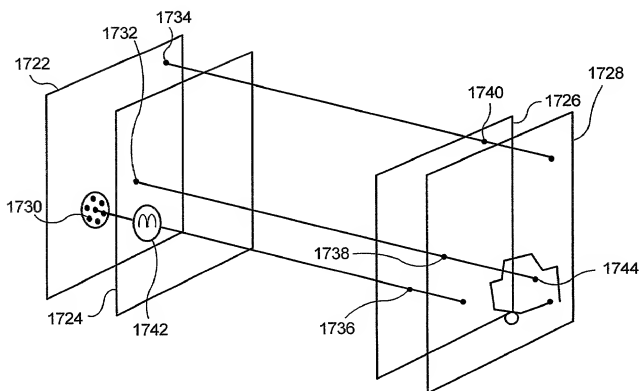


FIG. 49

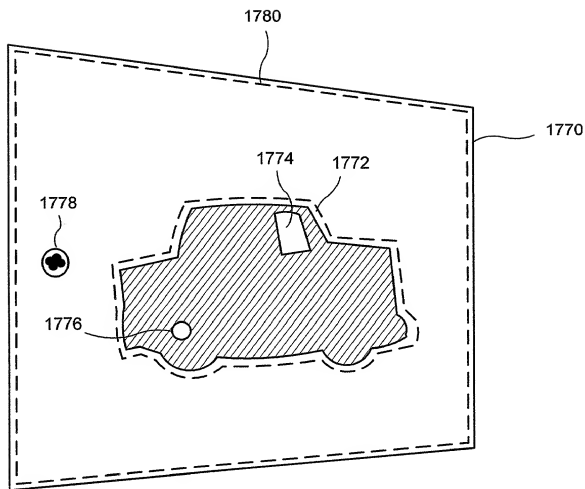


FIG. 51

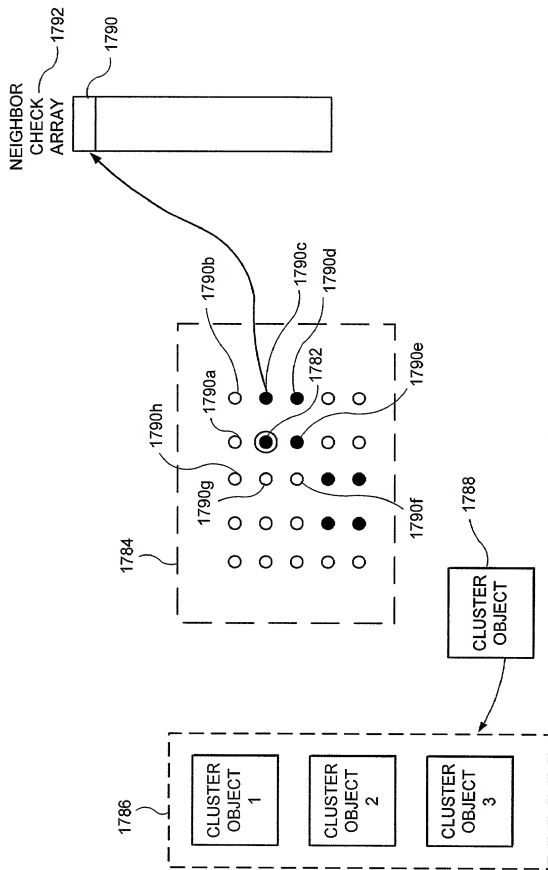


FIG. 52

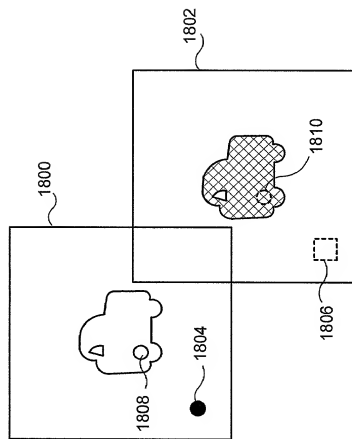


FIG. 53

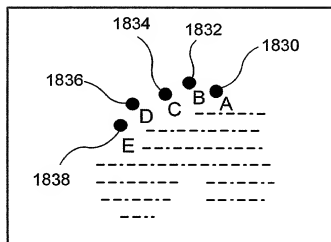


FIG. 54a

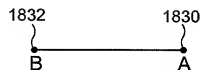


FIG. 54b

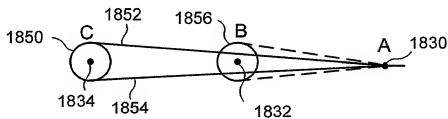


FIG. 54c

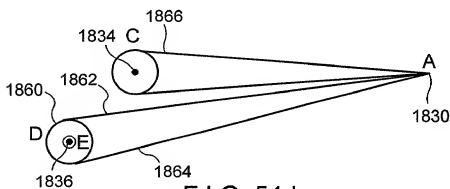


FIG. 54d

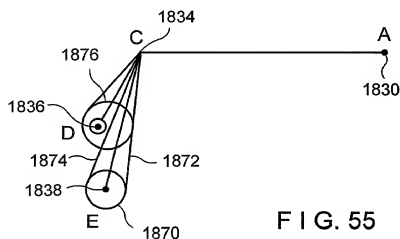


FIG. 55

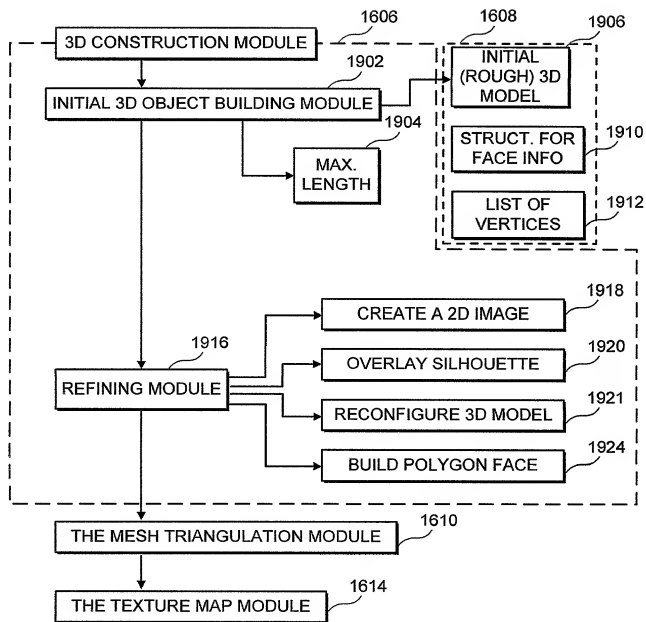


FIG. 56

```
graph TD; 1902[INITIAL 3D OBJECT BUILDING MODULE] --> 1940[DETERMINE THE MAXIMUM LENGTH FOR THE OBJECT ALONG THE Z AXIS]; 1940 --> 1904[MAX. LENGTH]; 1940 --> 1942[SELECT A POLYGONAL IMAGE OBJECT AS THE FIRST SILHOUETTE IMAGE TO PROCESS]; 1942 --> 1944[CREATE A SET OF BEGINNING AND ENDING POINTS (AND FAR AND CLOSE POLYGONS)]; 1944 --> 1946[ORDER THE VERTICES OF EACH FACE FOLLOWING AN E.G. CLOCKWISE ORDERING AND BUILD FACE OBJECTS]; 1946 --> 1948[INTERCONNECT THE FAR AND NEAR FACES WITH ADDITIONAL FACES (THIS CREATES A SOLID 3D OBJECT)];
```

1900

1902 INITIAL 3D OBJECT BUILDING MODULE

1940 DETERMINE THE MAXIMUM LENGTH FOR THE OBJECT ALONG THE Z AXIS

1904 MAX. LENGTH

1942 SELECT A POLYGONAL IMAGE OBJECT AS THE FIRST SILHOUETTE IMAGE TO PROCESS

1944 CREATE A SET OF BEGINNING AND ENDING POINTS (AND FAR AND CLOSE POLYGONS)

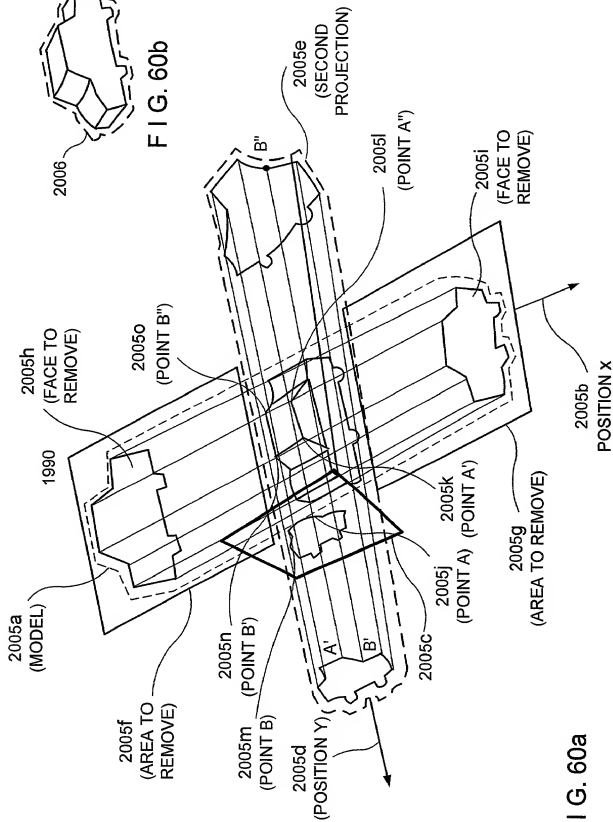
1946 ORDER THE VERTICES OF EACH FACE FOLLOWING AN E.G. CLOCKWISE ORDERING AND BUILD FACE OBJECTS

1948 INTERCONNECT THE FAR AND NEAR FACES WITH ADDITIONAL FACES (THIS CREATES A SOLID 3D OBJECT)

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F I G. 59



F I G. 60a



F I G. 60b

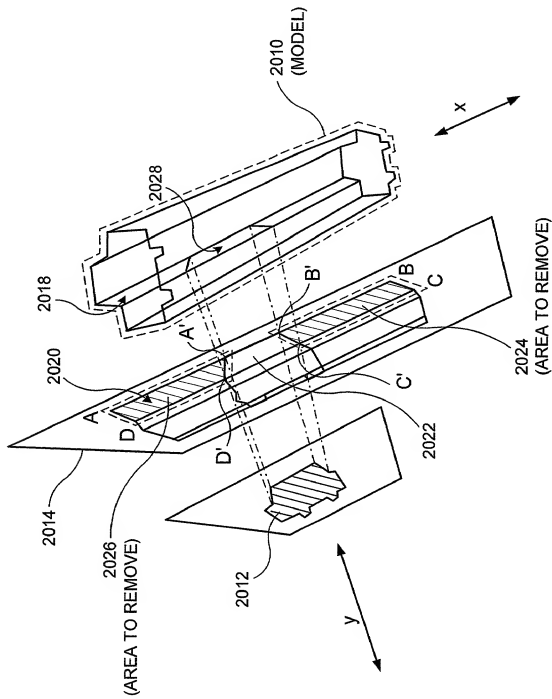


FIG. 61


```
graph TD
    2030[REFINING MODULE] --> 2031[LOOP TO PROCESS EACH REMAINING SILHOUETTE IMAGE]
    2031 --> 1916[GET REFERENCE TO THE SILHOUETTE IMAGE OBJECT]
    1916 --> 2032[CREATE A 2D PROJECTION OF THE 3D MODEL AND PROJECT THE SILHOUETTE POLYGON ON TO THIS PLANE]
    2032 --> 2034[MAKE A LIST OF FACES OF ALL THE FACES FROM THE MODEL'S 2D PROJECTION THAT INTERSECT WITH THE BOUNDS OF THE SILHOUETTE POLYGON]
    2034 --> 2035[LIST OF FACES WITH OVERLAP]
    2034 --> 2036[FOR EACH INTERCONNECTED FACE GENERATE A NEW SET OF COORDINATES ON THE X, Y PLANE TO BOUND THE AREA OF OVERLAP]
    2036 --> 2038[FOR THE NEWLY REVISED FACES, GENERATE ANY NEW 3D X, Y, Z, COORDINATES TO CORRESPOND TO THE NEW POINTS]
    2038 --> 2040[NEIGHBOR ADJUSTMENT PROCEDURE]
    2040 --> 2042[ADD ADDITIONAL FACES]
    2042 --> 2043([LOOP])
    2043 --> 2031
```

The flowchart illustrates the Refining Module (2030) process. It begins with a loop to process each remaining silhouette image (2031). The process then gets a reference to the silhouette image object (1916) and creates a 2D projection of the 3D model, projecting the silhouette polygon onto this plane (2032). Next, it makes a list of faces of all the faces from the model's 2D projection that intersect with the bounds of the silhouette polygon (2034). This step leads to a list of faces with overlap (2035) and also proceeds to the next step. For each interconnected face, it generates a new set of coordinates on the X, Y plane to bound the area of overlap (2036). Then, for the newly revised faces, it generates any new 3D X, Y, Z, coordinates to correspond to the new points (2038). This is followed by a neighbor adjustment procedure (2040), adding additional faces (2042), and finally looping back to the start of the process (2043).

FIG. 62

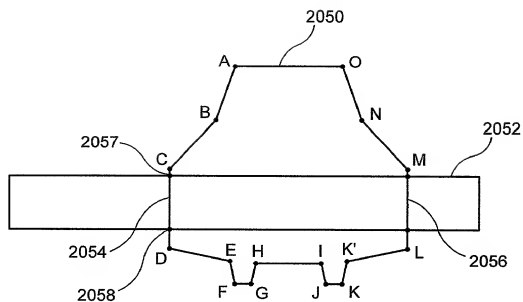


FIG. 63

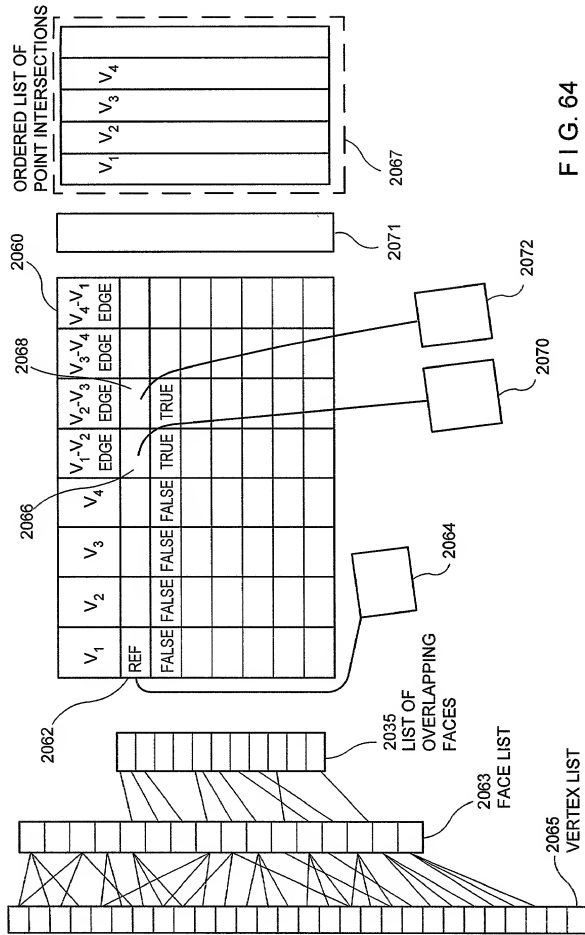


FIG. 64

```

graph TD
    2080[2080] --> 2081[2081 LOOP TO PROCESS EACH FACE REFERENCES ON THE "OVERLAP" LIST]
    2081 --> 2082[2082 GET THE REFERENCE TO THE NEXT FACE]
    2082 --> 2083[2083 BEGIN WITH A POINT OF THE SILHOUETTE IMAGE THAT LIES WITHIN THE BOUNDS OF THE CURRENT FACE]
    2083 --> 2084[2084 ADD THIS DATA POINT TO THE REVISED LIST OF POINTS FOR THE FACE]
    2084 --> 2085[2085 SET THIS POINT TO BE THE "ORIGIN POINT"]
    2085 --> 2092[2092 SET THIS POINT TO BE THE "CURRENT POINT" AND SET OTHER VARIABLES]
    2092 --> 2094[2094 GET THE NEXT POINT OF THE POLYGON SILHOUETTE BEING PROCESSED AND BEGIN A TOUR OF ITS POINTS MOVING IN THE DIRECTION OF THE VIEW OF THE FACE IN QUESTION]
    2094 --> 2095{2095 DETERMINE WHETHER THERE IS AN INTERSECTION BETWEEN THE SEGMENT DEFINED BY THE CURRENT POINT AND THE NEXT POINT AND ANY SEGMENT OF THE OBJECT THAT IS NOT BEING TOURED (i.e. EITHER THE SILHOUETTE POLYGON OR THE PROJECTED 2D IMAGE)}
    2095 --> 2096[2096 END OF TOUR]
    2095 --> 2094
    2096 --> 2081
  
```

F I G. 65a

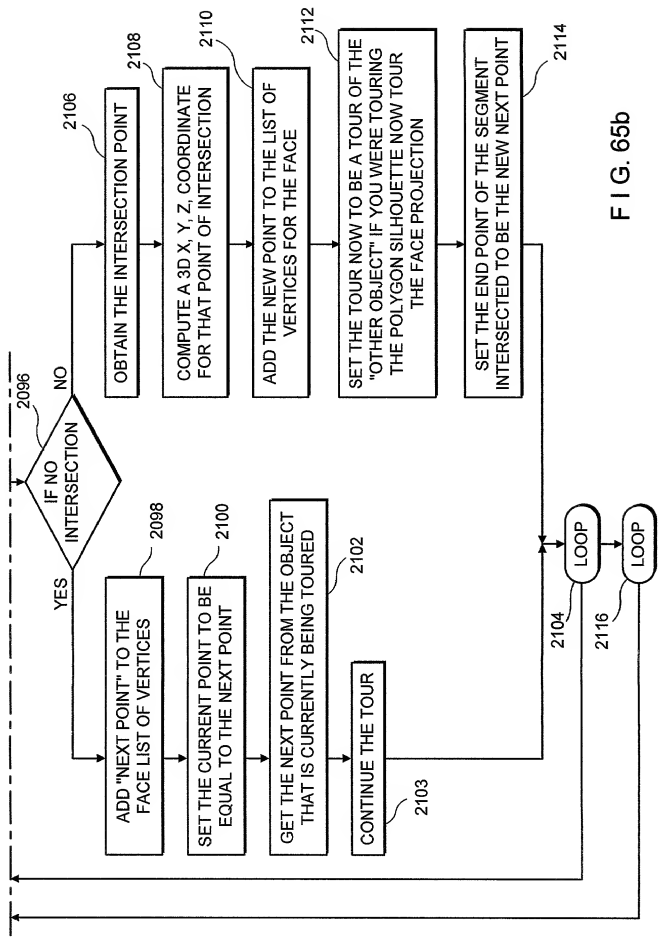


FIG. 65b

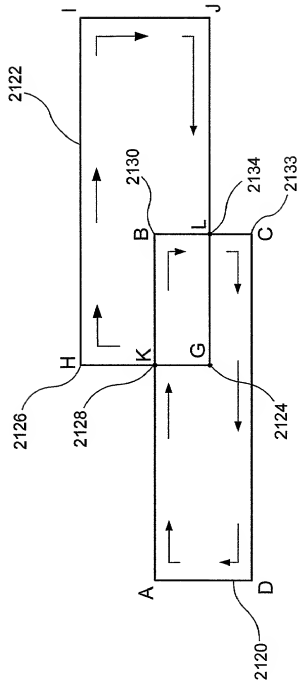


FIG. 66

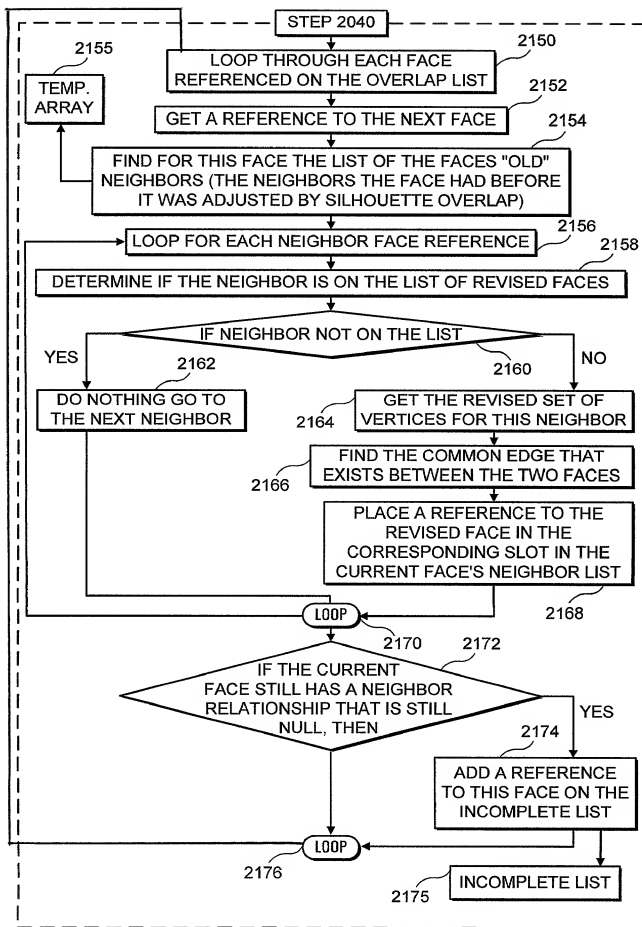


FIG. 67

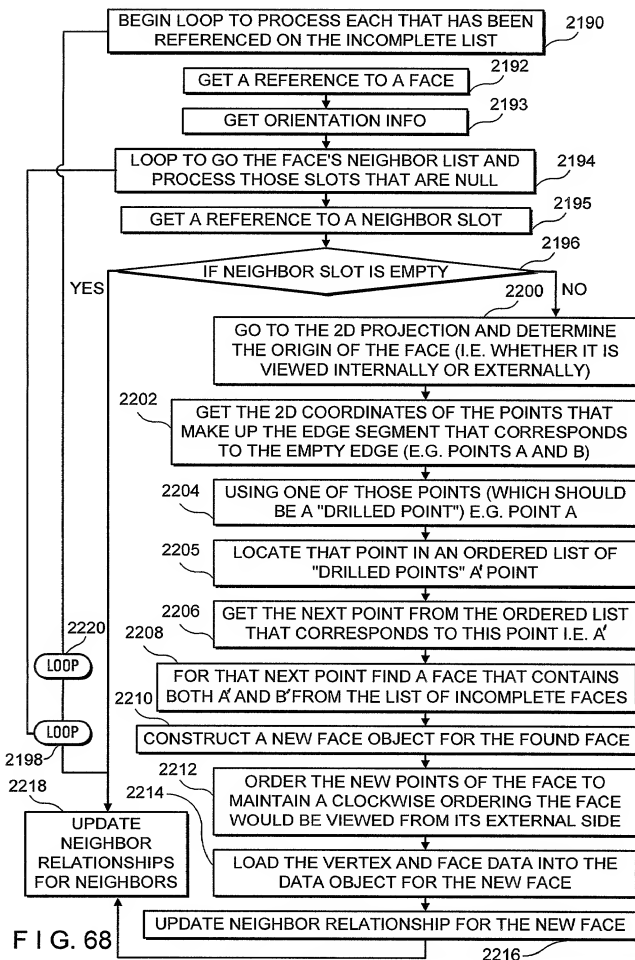


FIG. 68

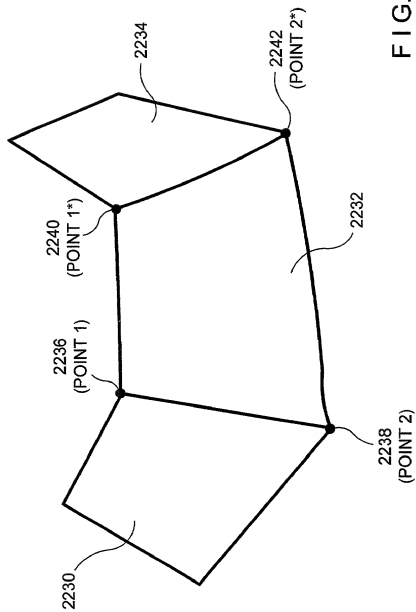


FIG. 69